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Paraboea dolomitica (Gesneriaceae), a new species from Guizhou, China

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Abstract

Here we describe *Paraboea dolomitica* Z.Y. Li, X.G. Xiang & Z.Y. Guo, a new species of Gesneriaceae from Guizhou, China. Based on recent extensive observations, this new species is morphologically similar to *Paraboea filipes* (Hance) Burtt, in having obovate leaf blades, 1–4-flowered cymes and purplish corolla, but differs from that species by the combination of denticulate leathery leaves, sparsely brown haired peduncles, two woolly bracts, reniform anthers and two glabrous staminodes. Additionally, molecular data support this new species as a member of a clade that includes *P. crassifolia*, *P. tetrabracteata*, *P. peltifolia*, *P. vetutina*, *P. dushanensis*, *P. dictyoneura*, *P xiangguiensis* and *P. guilinensis*, but it is distinct from them in leaf position, inflorescence, penduncle, bract and capsule. The conservation status of this species is considered to be "Vulnerable" (VU) according to the IUCN Red List Categories and Criteria.

Keywords

Gesneriaceae, limestone flora, new species, *Paraboea*

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Introduction

Paraboea was published by Clarke (1883) as a section of the *Didymocarpus* Wall. and subsequently treated as a distinct genus by Ridley (1905). Burtt (1984) recircumscribed *Paraboea* based on the indumentum instead of fruit morphology, and many species were transferred to *Paraboea* from the genus *Boea* Comm. ex Lam. Xu et al. (2008) revised this genus and recognised 89 species and five varieties. Using ITS and *trnL-F*, a recent molecular phylogenetic study indicated that *Trisepalum* C.B. Clarke and *Phylloboea* Benth. were nested in *Paraboea*, and consequently 15 new combinations in *Paraboea* were made (Puglisi et al. 2011). Further, Puglisi et al. (2016) established a new genus *Middletonia* segregated from *Paraboea*.

To date, *Paraboea* (C.B.Clarke) Ridley contains approximately 142 species and is distributed in southern China, northeastern India, the eastern Himalayas, Burma, Thailand, Cambodia, Laos, Vietnam, Malaysia, Philippines and Indonesia east to Sulawesi, occurring mostly in limestone regions (Xu and Burtt 1991; Xu 1994; Li and Wang 2004; Xu et al. 2008; Chen et al. 2008; Puglisi et al. 2011; Xu et al. 2012; Wen et al. 2013; Xu et al. 2017a; Puglisi and Phutthai 2018). Xu et al. (2017b) summarised that there are ca. 28 species in China, mainly in limestone areas of south and southwest China. Since then, one new species and one new record have been discovered in China (He et al. 2018; Lu et al. 2019). During our expeditions to Wuyang River, Zhenyuan County and Yuntai Mountain, Shibing County, Guizhou, China in 2016 and 2017, an unidentified species of *Paraboea* was collected. Based on morphological and molecular data, we concluded that it is a significant new species, which we describe here.

Materials and methods

Morphological observations

Morphological observations and measurements of the new species were carried out, based on living plants in the field and dry specimens in herbarium (PE and QNUN, herbarium acronyms according to Index Herbariorum; Thiers 2020). The photographs were taken in the field. All morphological characters were studied under dissecting microscopes and are described using the terminology presented by Wang et al. (1998).

Taxon sampling and DNA sequencing

A total of 60 species of *Paraboea* were sampled. Based on Roalson and Roberts (2016) and Xu et al. (2017a), seven species (*Middletonia evrardii* (Pellegr.) C.Puglisi, *Middletonia monticola* (Triboun & D.J.Middleton) C.Puglisi, *Middletonia multiflora* (R.Br.) C.Puglisi, *Isometrum farreri* Craib, *Kaisupeea herbacea* (C.B.Clarke) B.L.Burtt, *Ornithoboea arachnoidea* (Diels) Craib and *Ornithoboea wildeana* Craib) were selected as

outgroups. No material of *P. filipes* (Hance) Burtt, the most morphologically-similar species, was available for analysis.

Total genomic DNA was extracted from leaves dried in silica gel using the Plant Genomic DNA Kit (CW Biotech, Beijing, China). The nuclear internal trancribed spacer (ITS) and chloroplast $trnL^{UAA}$-F^{GAA} (including intron and spacer) were used in this study. The primers for ITS were ITS-5P (5'-GGA AGG AGA AGT CGT AAC AAG G-3') and ITS-8P (5'-CAC GCT TCT CCA GAC TAC-3') (Möller and Cronk 1997) and primers for *trnL-F* were *c* (5'-CGA AAT CGG TAG ACG CTA CG-3') and *f* (5'-ATT TGA ACT GGT GAC ACG AG-3') (Taberlet et al. 1991). The selected DNA regions were amplified with standard polymerase chain reaction (PCR) and products were analysed by MajorBio company (Beijing, China). Voucher information and GenBank accession numbers are listed in Appendix 1. Except for sequences of the new species that were generated in this study, others are from GenBank.

Alignment and Phylogenetic analysis

Sequences were aligned using the default parameters in CLUSTAL X v1.83 (Thompson et al. 1997) and manually adjusted with BIOEDIT v5.0.9 (Hall 1999). Phylogenetic analyses were carried out using Maximum Parsimony (MP) and Bayesian Inference (BI) methods in PAUP v4.0b10 (Swofford 2003) and MrBayes v3.2.0 (Ronquist and Huelsenbeck 2003), respectively. For MP analyses, heuristic searches were performed with 1000 random sequence addition replicates, tree-bisection-reconnection (TBR) branch swapping, MulTrees in effect and steepest descent off. Gaps were treated as missing data, characters were equally weighted and their states were unordered. Internal branch support was estimated by using 1000 bootstrap replicates (Felsenstein 1985), as described above. For BI analyses, the nucleotide substitution model was determined by the Akaike Information Criterion (AIC) in Modeltest v3.06 (Posada and Crandall 1998). Four chains of the Markov Chain Monte Carlo (MCMC) were run over 3 million generations, sampling one tree every 1000 generations, starting with a random tree. Majority rule (> 50%) consensus tree was constructed after removing the burn-in period samples (the first 25% of the sampled trees).

Results

The concatenated DNA matrix had a length of 1944 aligned characters (ITS: 993 bp and *trnL-F*: 951 bp), of which 838 were variable and 475 are parsimony-informative. MP and BI analyses resulted in congruent topologies except for some clades with low supported values (Fig. 1). The genus *Paraboea* was supported as a monophyletic with strong support values. The major phylogenetic relationships amongst *Paraboea* were consistent with Xu et al. (2017a). The two samples of the new species from different sites are shown as a distinct clade (Posterior Probability (PP) = 1.00, Bootstrap

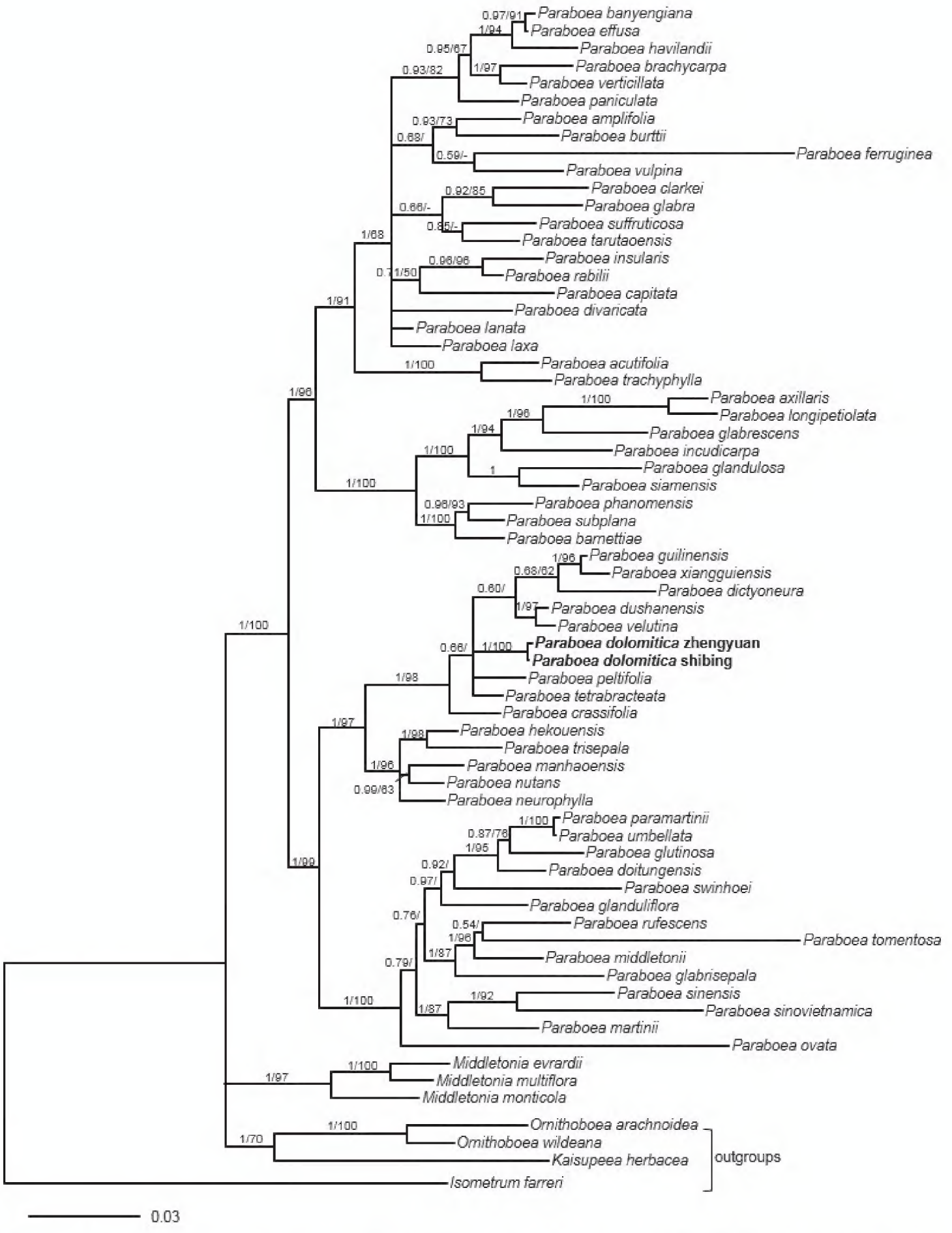

Figure 1. The majority consensus tree of the Bayesian Inference method based on ITS and *trnL-F* regions. Bayesian posterior probabilities and bootstrap support values (> 50%) are shown above the branch. The new species is highlighted in bold.

value (BS) = 100%). The new species forms a monophyletic clade with *P. crassifolia*, *P. tetrabracteata*, *P. peltifolia*, *P. vetutina*, *P. dushanensis*, *P. dictyoneura*, *P xiangguiensis* and *P. guilinensis* (PP = 1.00, BS = 98%), but its sister group is uncertain (Fig. 1).

Taxonomic treatment

***Paraboea dolomitica* Z.Y. Li, X.G. Xiang & Z.Y. Guo, sp. nov.**
urn:lsid:ipni.org:names:77210596-1
Figs 2, 3

Diagnosis. *Paraboea dolomitica* is morphologically similar to *P. filipes*. Both of them have obovate leaf blades, 1–4-flowered cymes and a purplish corolla, but *P. dolomitica* differs from *P. filipes* by its leathery leaves with denticulate margins (*vs.* papery leaves with subentire margins in *P. filipes*), peduncles sparsely covered with brown hairs (vs. sparsely sericeous-lanate when young and glabrate when mature), two woolly bracts (vs. two glabrous bracts), reniform anthers (vs. oblong anthers), two staminodes 0.3 cm long (vs. 1 staminodes 0.02 cm long), and flowering during April and May (vs. flowering during September and October) (Table 1).

Phylogenetic analysis suggested that *P. dolomitica* was nested in a clade including *P. crassifolia* (Hemsl.) Burtt, *P. tetrabracteata* F. Wen, Xin Hong & Y. G. Wei, *P. peltifolia* D. Fang et Z. Zeng, *P. vetutina* (W. T. Wang et C. Z. Gao) Burtt, *P. dushanensis* W. B. Xu & M. Q. Han, *P. dictyoneura* (Hance) Burtt, *P xiangguiensis* W. B. Xu & B. Pan and *P. guilinensis* L. Xu et Y. G. Wei, but *P. dolomitica* can be easily differentiated from them in leaf position, inflorescence, penduncle, bract and capsule. The detailed morphological comparison of the species most morphologically similar to *P. dolomitica* is listed in Table 1.

Type. China. Guizhou: Shibing County, Yuntai Mountain, 27°06'80.7"N, 108°07'00.0"E, elevation 885 m, on rock faces of a karst dolomite cave, 2 May 2017, Z.Y. Guo 20170047 (holotype: PE!; isotypes: PE!, QNUN!).

Perennial herbs. Rhizomes subterete, 1.5–6.0 cm long, 0.3–0.5 cm diam. Roots slender, fibrous. Leaves crowded near stem apex, opposite; blade leathery, obovate to elliptic, 2.5–4.5 cm long, 1.0–1.5 cm wide, apex acute or rounded, base rounded to broadly cuneate, margin denticulate, involute; adaxial surface with arachnoid covering when young, but glabrescent when mature, abaxially densely brown woolly; principal vein depressed above, raised beneath, lateral veins 3–6 on each side of midrib, tertiary venation inconspicuous; petiole 0.8–2.0 cm long, 0.2–0.3 cm broad, densely covered with appressed velvety hairs. Cymes axillary, umbel-like 1–4-flowered; peduncle 3–5 cm long, 0.05–0.08 cm in diameter, sparsely lanate and glandulose-pubescent. Bracts 2, 0.3–0.4 cm long, linear, woolly beneath; pedicel 0.8–2.2 cm long, 0.05–0.1 cm in diameter, sparsely lanate with glandular hairs. Calyx 5-parted, 0.4–0.6 cm long, 0.1–0.15 cm in diameter, apex acute, densely brown woolly; segments linear. Corolla oblique-campanulate, zygomorphic, purplish, 1.0–1.2 cm long, outside and inside glabrous; tube 0.5–0.6 cm long; throat ca. 0.7 cm in diameter; adaxial lip 2-lobed, lobes orbicular or deltoid, abaxial lip 3-lobed, lobes oblong-elliptic or oblong. Stamens 2, glabrous; filaments 0.5–0.6 cm long, ca. 0.08 cm in diameter, yellow, curved at the upper part; anthers reniform, ca. 0.3 cm long, 0.2 cm broad; staminodes 2, linear, ca. 0.3 cm long. Pistil glabrous, ovary linear, stigma capitate. Capsule linear, 1.5–1.8 cm long, 0.15–0.2 cm broad, glabrous, slightly twisted.

Table 1. Morphological comparisons between *Paraboea dolomitica* and its relatives its relatives based on morphological observation and phylogenetic analyses.

Characters	*P. dolomitica*	*P. filipes*	*P. dictyoneura*	*P. crassifolia*	*P. dushanensis*	*P. peltifolia*
Rhizome	1.5–6.0 cm long, ca. 0.3–0.5 cm diam.	up to 2.5 cm long, ca. 0.3 cm diam.	1.5–2.5 cm long, 0.7–0.8 cm diam.	0.5–1.5 cm long, 0.5–0.9 cm diam.	4–10 cm long, 0.2–0.6 cm diam.	2–7 cm long, 0.5–1 cm diam.
Stem	present	absent	absent or up to 10 cm	absent or up to 15 cm	absent	present
Leaf position	crowded near the stem apex, opposite	basal, rosette	basal or crowded near the stem apex, rosette	basal or crowded near the stem apex	congested at the apex of rhizome	spiral at the stem apex
Leaf blade	leathery, obovate to elliptic, 2.5–4.5 × 1.0–1.5 cm, margin denticulate	papery, obovate to obovate-oblong, (1-) 2–5 × (0.3-) 0.7–2.2 cm, margin shallowly crenate or subentire	thick papery, oblanceolate, 7–19 × 1.2–4.5 cm, margin serrate to dentate or subentire	thick papery, obovate or ovate, 3–16 × 1.5–7 cm, margin crenate to denate or subentire	leathery, cuneate to attenuate, 4–8 × 0.7–1.5 cm, margin crenate to shallowly repand	papery, obovate to oblanceolate, spatulate or subspatulate, 6–33.5 × 3–14.3 cm, margin crenate-serrate
Cymes	1–4-flowered	1–4-flowered	5–20-flowered	4–12-flowered	1–5-flowered	2–15-flowered
Peduncle	3–5 cm long, sparsely lanate with glandular hairs	3–7 cm long, glabrescent	8–21 cm long, pannose to sparsely pannose	3–12 cm long, woolly to pannose	3–5 cm long, ferruginous matted indumentum	4–6 cm long, woolly
Bract	2, linear, 0.3–0.4 cm long	2, narrowly oblong-ovate, ca. 0.1 cm long	2 or 3, lanceolate to narrowly oblong, 0.5–1.3 cm long	2, linear to subulate, 0.2–0.5 cm long	2, linear-lanceolate, 0.3–0.5 cm long	2, lanceolate-triangular, 0.2–0.3 (-0.4) cm long
Calyx	5-parted	5-parted	5-parted	5-parted	5-parted	2-lipped
Corolla	purplish	purplish	purplish	purplish	purple-blue	white
Anther	reniform	narrowly oblong	oblong	oblong	elliptic	reniform
Staminodes	2, 0.3 cm long	1, ca. 0.02 cm long	3, 0.2–0.45 cm long	2, 0.2–0.25 cm long	3, 0.25–0.3 cm long	2, 0.2 cm long
Capsule	1.5–1.8 cm long, slightly twisted	0.5–1.1 cm long, not twisted	1.5–6 cm long, spirally twisted to nearly straight	2–4.5 cm long, spirally twisted	1.2–3.1 cm long, not twisted	1–3.6 cm long, not twisted
Flowering	April and May	September and October	April and May	June and July	May and June	March and April

Note: The morphological characters of *P. filipes*, *P. dictyoneura*, *P. crassifolia* and *P. peltifolia* are from Li and Wang (2004) and the characters of *P. dushanensis* are from Xu et al. (2017a).

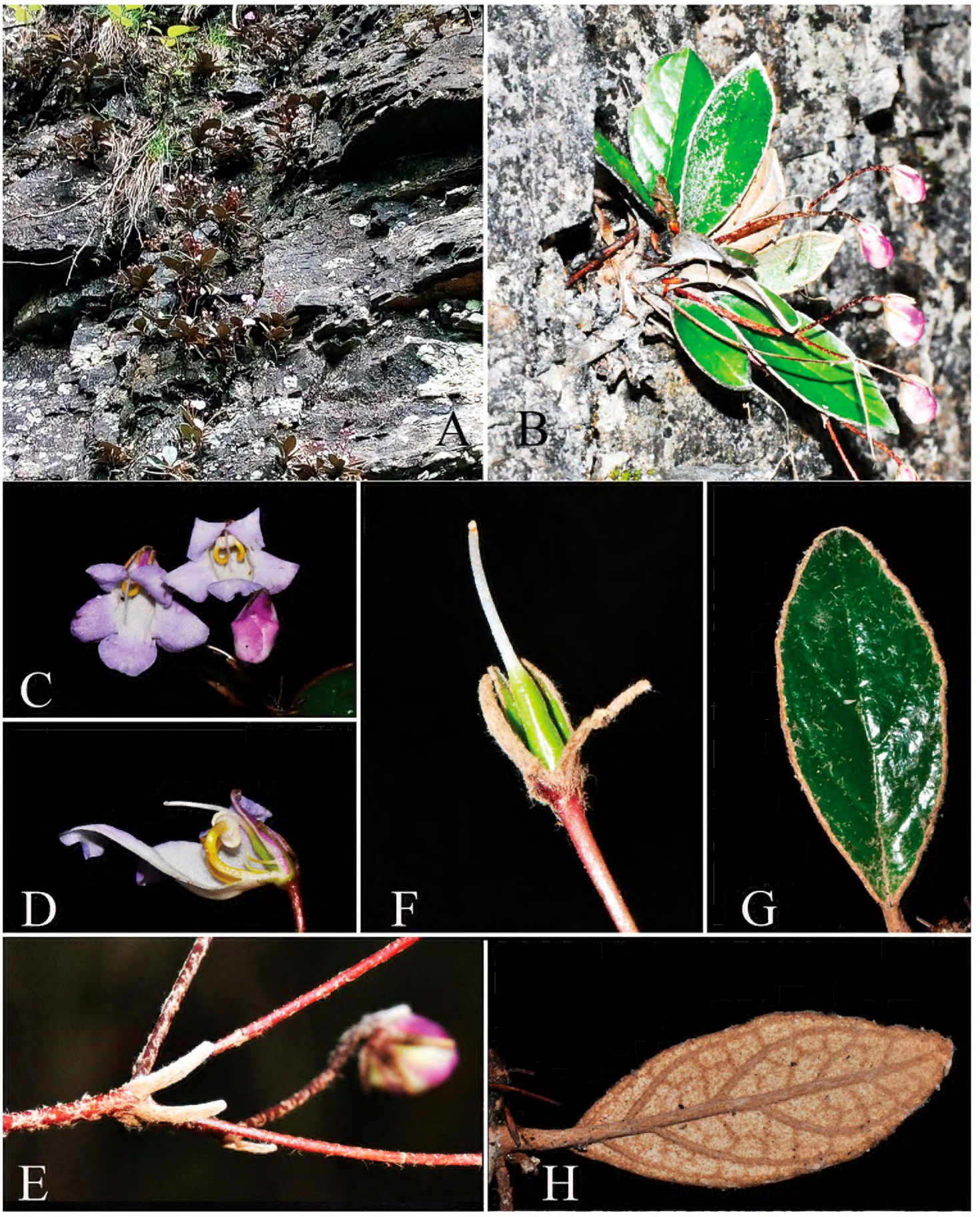

Figure 2. *Paraboea dolomitica*. **A** Habitat **B** flowering habit **C** flower face view **D** opened corolla showing stamens, staminodes and pistil **E** bracts **F** pistil with calyx **G** adaxial leaf blade; and **H** abaxial leaf blade.

Distribution. *Paraboea dolomitica* is known from Yuntai Mountain, Shibing County and Wuyang River, Zhenyuan County, Guizhou, China.

Phenology. Flowering occurs in April and May and the fruiting occurs between June and August.

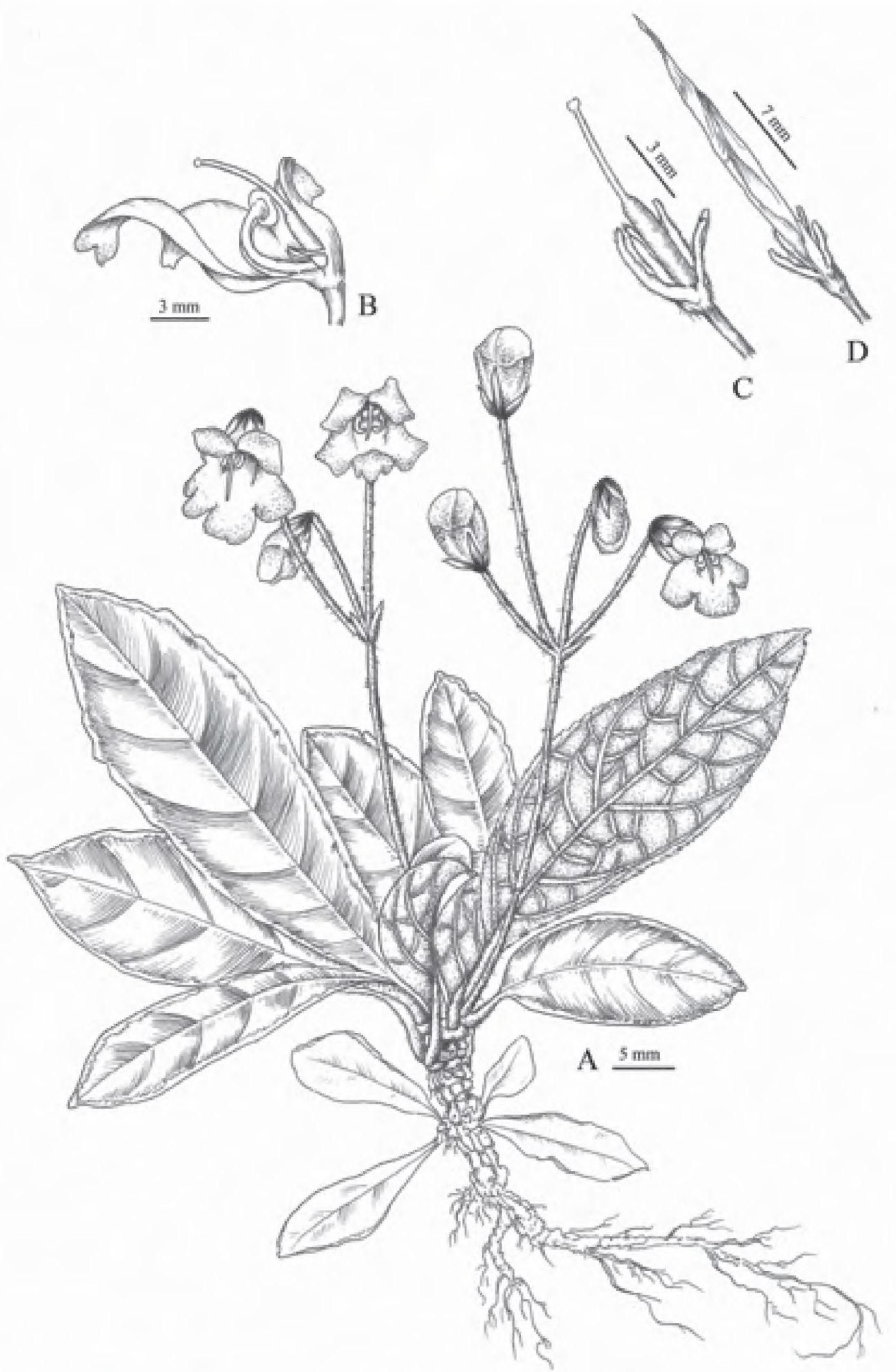

Figure 3. *Paraboea dolomitica*. **A** Flowering habit **B** opened corolla showing stamens, staminode and pistil **C** pistil with calyx and **D** capsule. Drawn by Zhaowen Wu based on holotype and isotypes.

Etymology. The specific epithet refers to the habitat of this new species, the dolomite karst area.

Habitat and ecology. *Paraboea dolomitica* grows on rock faces of dolomite karst area, at an elevation of ca. 650–855 m. Accompanying plants in the habitat are sparse and include trees, such as *Platycarya strobilacea* Sieb. et Zucc., *Cotinus coggygria* Scop., and herbs such as *Selaginella moellendorfii* Hieron., *Paphiopedilum micranthum* T. Tang et F. T. Wang, *Viola diffusa* Ging., *Galium aparine* Linn. var. *echinospermum* (Wallr.) Cuf. and *Carex* sp.

Additional collections. China. Guizhou: Zhenyuan County, Wuyang River, 27°06'80.7"N, 108°07'00.0"E, elevation 650 m, on rock faces, 3 August 2016, Guo ZY, GZY1608721 (PE and QNUN), GZY1608723 (PE and QNUN), GZY1608724 (PE and QNUN).

Proposed IUCN conservation status

The new species has only been found in Shibing County and Zhenyuan County, Guizhou, China. The populations and habitats are vulnerable to human activities such as road construction and deforestation for crops. According to field observations, it has several known populations of less than 300 mature individuals according to field observations. The species is considered to be "Vulnerable" (VUD1) according to the IUCN Red List Criteria (IUCN 2017), based on Criterion D1 and population size, estimated to be fewer than 1000 mature individuals.

Acknowledgements

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References

Burtt BL (1984) Studies in the Gesneriaceae of the Old World: XLVII. Revised generic concepts for *Boea* and its allies. Notes from the Royal Botanic Garden Edinburgh 41: 401–452.

Chen WH, Möller M, Shui YM, Zhang MD (2008) A new species of *Paraboea* (Gesneriaceae) from a karst cave in Guangxi, China, and observations on variations in flower and inflorescence architecture. Botanical Journal of the Linnean Society 158(4): 681–688. https://doi.org/10.1111/j.1095-8339.2008.00873.x

Clarke CB (1883) Cyrtandreae. In: Candolle A de, Candolle C de (Eds) Monographiae Phanerogamarum, vol. 5. Masson, Paris.

Felsenstein J (1985) Confidence limits on phylogenies: An approach using the bootstrap. Evolution 39(4): 783–791. https://doi.org/10.1111/j.1558-5646.1985.tb00420.x

Hall TA (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. Nuclear Acids Symposia Series 41(41): 95–98.

He DM, Feng YF, Pan FZ, Hong X, Wen F (2018) *Paraboea wenshanensis*, a new species of Gesneriaceae from Yunnan, China. PhytoKeys 95: 83–91. https://doi.org/10.3897/phytokeys.95.21586

IUCN (2017) Guidelines for using the IUCN Red List Categories and Criteria. Version 13. IUCN Standards and Petitions Subcommittee. http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Li ZY, Wang YZ (2004) Plants of Gesneriaceae in China. Henan Sciences & Technology Publishing House, Zhengzhou. [In Chinese]

Lu ZC, Liu ED, Han MQ, Zhu XX, Nguyen KS, Xu WB (2019) Discovery of *Paraboea minutiflora* (Gesneriaceae) from southeastern Yunnan, China with supplementary description. Guihaia (online).

Möller M, Cronk QC (1997) Phylogeny and disjunct distribution: evolution of *Saintpaulia* (Gesneriaceae). Proceedings of the Royal Society London: Biological Sciences 264(3689): 1827–1836. https://doi.org/10.1098/rspb.1997.0252

Posada D, Crandall KA (1998) Modeltest: Testing the model of DNA substitution. Bioinformatics (Oxford, England) 14(9): 817–818. https://doi.org/10.1093/bioinformatics/14.9.817

Puglisi C, Phutthai T (2018) A new species of *Paraboea* (Gesneriaceae) from Thailand. Edinburgh Journal of Botany 75(1): 51–54. https://doi.org/10.1017/S0960428617000324

Puglisi C, Middleton DJ, Triboun P, Möller M (2011) New insights into the relationships between *Paraboea*, *Trisepalum* and *Phylloboea* (Gesneriaceae) and their taxonomic consequences. Taxon 60(6): 1693–1702. https://doi.org/10.1002/tax.606014

Puglisi C, Yao TL, Milne R, Moller M, Middleton DJ (2016) Generic recircumscription in the Loxocarpinae (Gesneriaceae), as inferred by phylogenetic and morphological data. Taxon 65(2): 277–292. https://doi.org/10.12705/652.5

Ridley HN (1905) The Gesneriaceae of the Malay Peninsula. Journal of the Straits Branch of the Royal Asiatic Society 44(1): 1–92.

Roalson EH, Roberts WR (2016) Distinct processes drive diversification in different clades of Gesneriaceae. Systematic Biology 65(4): 662–684. https://doi.org/10.1093/sysbio/syw012

Ronquist F, Huelsenbeck JP (2003) MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics (Oxford, England) 19(12): 1572–1574. https://doi.org/10.1093/bioinformatics/btg180

Swofford DL (2003) PAUP*. Phylogenetic analysis using parsimony (* and other methods), ver. 4.0b10. Sinauer Associtates.

Taberlet P, Gielly L, Pautou G, Bouvet J (1991) Universal primers for amplification of three non-coding regions of chloroplast DNA. Plant Molecular Biology 17(5): 1105–1109. https://doi.org/10.1007/BF00037152

Thiers B (2020) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih. [accessed: 7 May 2020]

Thompson JD, Gibson TJ, Plewniak F, Jeanmougin F, Higgins DG (1997) The CLUSTAL_X windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. Nucleic Acids Research 25(24): 4876–4882. https://doi.org/10.1093/nar/25.24.4876

Wang WT, Pan KY, Li ZY, Weitzman AL, Skog LE (1998) Gesneriaceae. In: Wu ZY, Raven PH (Eds) Flora of China, Vol. 18. Science Press and Missouri Botanical Garden Press, Beijing and St. Louis, 362–367.

Wen F, Hong X, Chen LY, Zhou SB, Wei YG (2013) A new species of *Paraboea* (Gesneriaceae) from a karst limestone hill in southwestern Guangdong, China. Phytotaxa 131(1): 1–8. https://doi.org/10.11646/phytotaxa.131.1.1

Xu ZR (1994) A new species of *Paraboea* Ridley from Thailand. Zhiwu Fenlei Xuebao 32(4): 359–361. http://www.jse.ac.cn/EN/Y1994/V32/I4/359

Xu ZR, Burtt BL (1991) Towards a revision of *Paraboea* (Gesneriaceae): I. Edinburgh Journal of Botany 48(1): 1–18. https://doi.org/10.1017/S0960428600003541

Xu ZR, Burtt BL, Skog LE, Middleton DJ (2008) A revision of *Paraboea* (Gesneriaceae). Edinburgh Journal of Botany 65(2): 161–347. https://doi.org/10.1017/S0960428608005106

Xu WB, Huang YS, Wei GF, Tan WN, Liu Y (2012) *Paraboea angustifolia* (Gesneriaceae): A new species from limestone areas in northern Guangxi, China. Phytotaxa 62(1): 39–43. https://doi.org/10.11646/phytotaxa.62.1.8

Xu WB, Guo J, Pan B, Han MQ, Liu Y, Chung KF (2017a) Three new species of *Paraboea* (Gesneriaceae) from limestone karsts of China based on morphological and molecular evidence. Botanical Studies (Taipei, Taiwan) 58(1): 56. https://doi.org/10.1186/s40529-017-0207-5

Xu WB, Guo J, Pan B, Zhang Q, Liu Y (2017b) Diversity and distribution of Gesneriaceae in China. Guihaia 37(10): 1219–1226.

Appendix 1

GenBank accession numbers (species: voucher, trn*L-F*, ITS). The dash indicated that there is no data

Ingroups: *Paraboea acutifolia*, JN934711, FJ501314; *Paraboea amplifolia*, JN934712, JN934754; *Paraboea axillaris*, KU203943, KU203848; *Paraboea banyengiana*, JN934713, JN934755; *Paraboea barnettiae*, AJ492306, KU203847; *Paraboea birmanica*, HQ632866, HQ632958; *Paraboea brachycarpa*, FJ501465, KU203870; *Paraboea burttii*, JN934714, JN934756; *Paraboea capitata*, AJ492298, FJ501315; *Paraboea clarkei*, JN934715, JN934757; *Paraboea crassifolia*, FJ501472, FJ501318; *Paraboea dictyoneura*, FJ501463, KJ475415; *Paraboea divaricata*, JN934717, JN934759; *Paraboea doitungensis*, KU203941, KU203846; ***Paraboea dolomitica*, Z.Y. Guo 20170047**, MT379849, MT379851; ***Paraboea dolomitica*, GZY 1608721**, MT379850, MT379852**;** *Paraboea dushanensis*, MF358716, MF358698; *Paraboea effusa*, JN934718, JN934760; *Paraboea ferruginea*, FJ501471, KU203862; *Paraboea glabra*, JN934719, JN934761; *Paraboea glabrescens*, JN934743, JN934785;

Paraboea glabrisepala, JN934720, JN934762; *Paraboea glanduliflora*, JN934721, JN934763; *Paraboea glandulosa*, HQ632867, JN934784; *Paraboea glutinosa*, JN934722, JN934764; *Paraboea guilinensis*, MF358717, MF358701; *Paraboea havilandii*, JN934724, JN934766; *Paraboea hekouensis*, KU203938, KU203843; *Paraboea incudicarpa*, JN934725, JN934767; *Paraboea insularis*, KU203952, KU203857; *Paraboea lanata*, FJ501467, –; *Paraboea laxa*, FJ501466, –; *Paraboea longipetiolata*, KU203946, KU203851; *Paraboea martinii*, MF358718, MF358702; *Parabora manhaoensis*, KU203937, KU203842; *Paraboea middletonii*, KU203940, KU203845; *Paraboea neurophylla*, JN934727, JN934769; *Paraboea nutans*, MF358719, MF358703; *Paraboea paniculata*, JN934728, JN934770; *Paraboea paramartinii*, JN934729, JN934771; *Paraboea peltifolia*, MF358720, –; *Paraboea phanomensis*, KU203950, KU203855; *Paraboea rabilii*, KU203951, KU203856; *Paraboea rufescens*, JN934730, JN934772; *Paraboea siamensis*, KU203948, KU203853; *Paraboea sinensis*, JN934731, JN934773; *Paraboea sinovietnamica*, MF358722, MF358706; *Paraboea subplana*, JN934744, JN934786; *Paraboea suffruticosa*, JN934732, JN934774; *Paraboea swinhoei*, FJ501475, JN934775; *Paraboea tarutaoensis*, JN934734, JN934776; *Paraboea tetrabracteata*, MF358723, MF358707; *Paraboea tomentosa*, KU204043, KU203971; *Paraboea trachyphylla*, JN934735, JN934777; *Paraboea trisepala*, JN934736, JN934778; *Paraboea umbellata*, JN934737, FJ501317; *Paraboea velutina*, JN934738, JN934780; *Paraboea verticillata*, JN934739, JN934781; *Paraboea vulpina*, JN934740, JN934782; *Paraboea xiangguiensis*, MF358728, MF358711.

Outgroups: *Middletonia evrardii*, KU203885, KU203790; *Middletonia monticola*, KU203884, KU203789; *Middletonia multiflora*, MU203886, MU203791; *Isometrum farreri*, JF697585, HQ327464; *Kaisupeea herbacea*, FJ501459, FJ501309; *Ornithoboea arachnoidea*, JN934709, FJ501312; *Ornithoboea wildeana*, JN934710, JN934752.